

# PMT Calibration / Greenhouses

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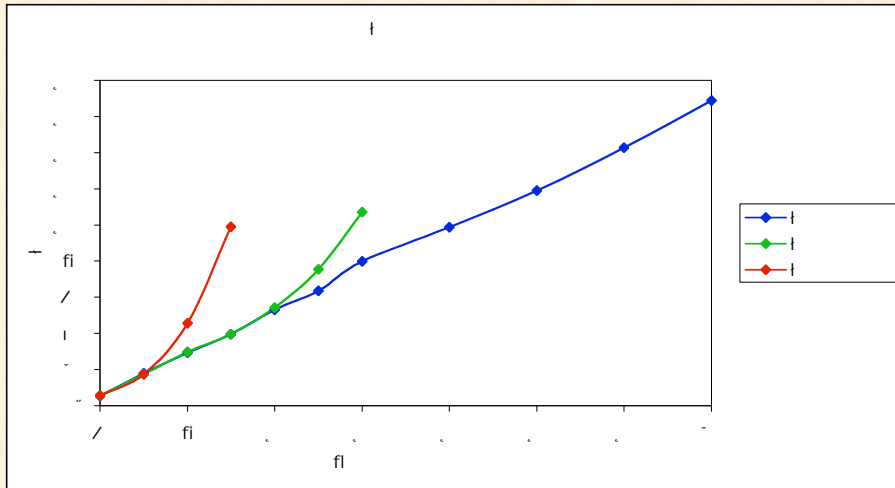
# PMT Calibration

# Goals

- Transform raw data into graphs for 30 PMTs
- Observe how the gain and # of photoelectrons (PE) change as a LED intensity changes
- Observe how the gain and # of PE change as high voltage changes
- Find the stable region of each PMT by analyzing the noise
- Extrapolate PMT data
- Ensure the linearity of each PMT
- Further test the PMTs

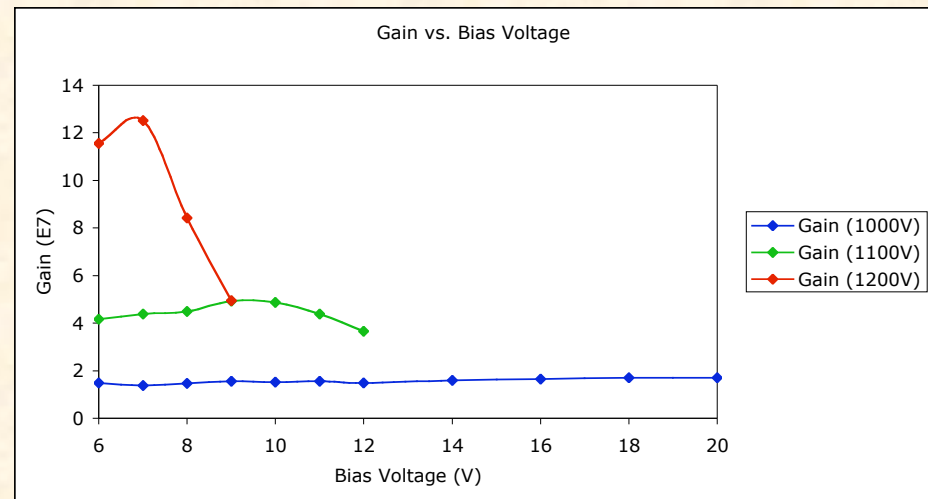
# LED intensity

- Increasing the LED intensity while keeping the high voltage constant



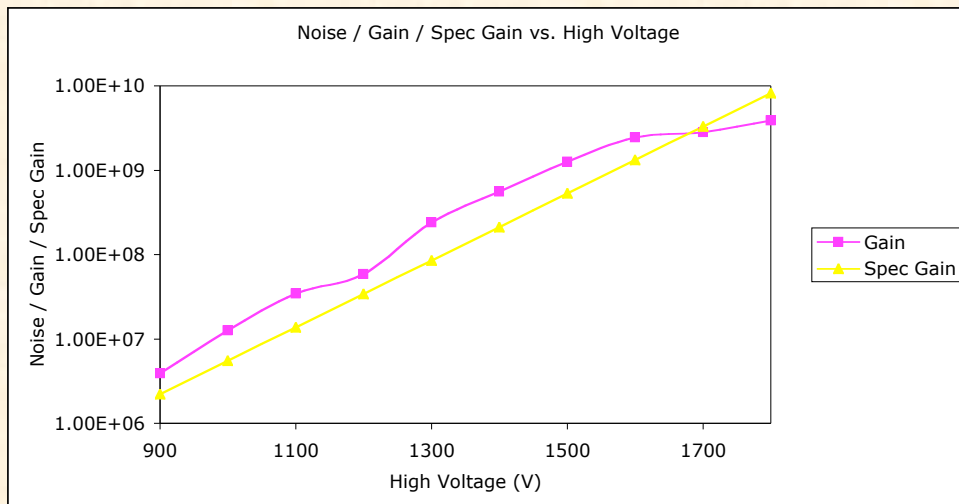
As the PMTs become saturated the PE cannot be measured accurately

As the PE cannot be measured the gain is no longer constant



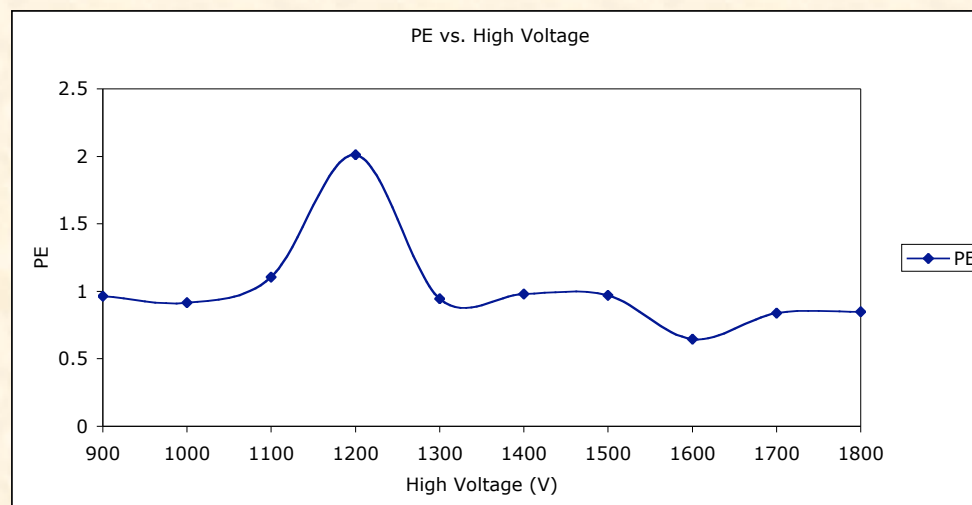
# High Voltage

- Increasing the high voltage while keeping the LED intensity constant



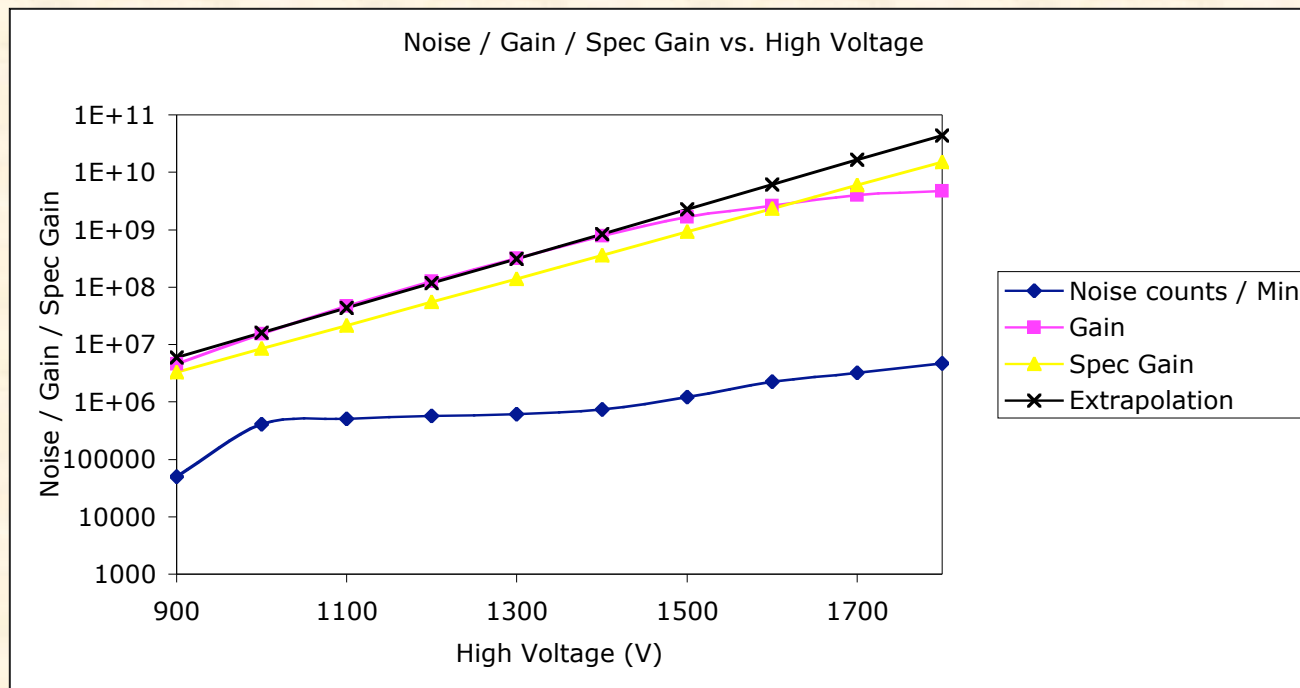
Comparing the experimental gain vs. the specification gain from the company

Approximately 1 PE should be hitting the PMT for these tests. This plot ensured that.



# Noise counts / min and Extrapolation

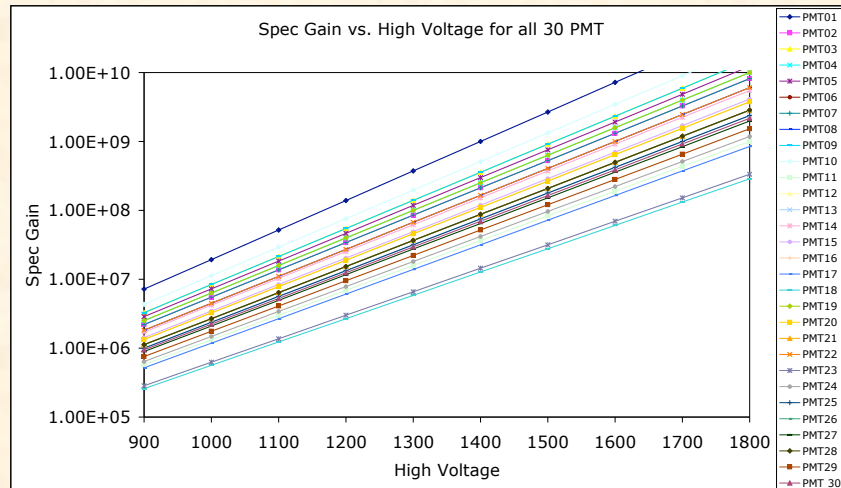
- We then added the noise counts / min to find the stable region of each PMT
- We also extrapolated the data to find the high voltage that would give us a gain of  $5E7$



Our gain of  $5E7$  is right in the stable region of the PMT

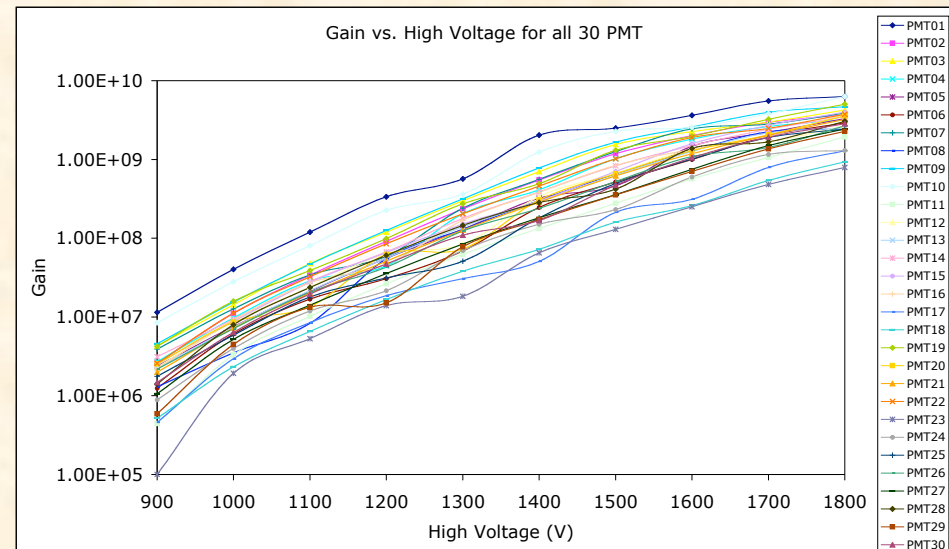
# All 30 PMT

- Spec gain vs. high voltage and gain vs. high voltage for all 30 PMT



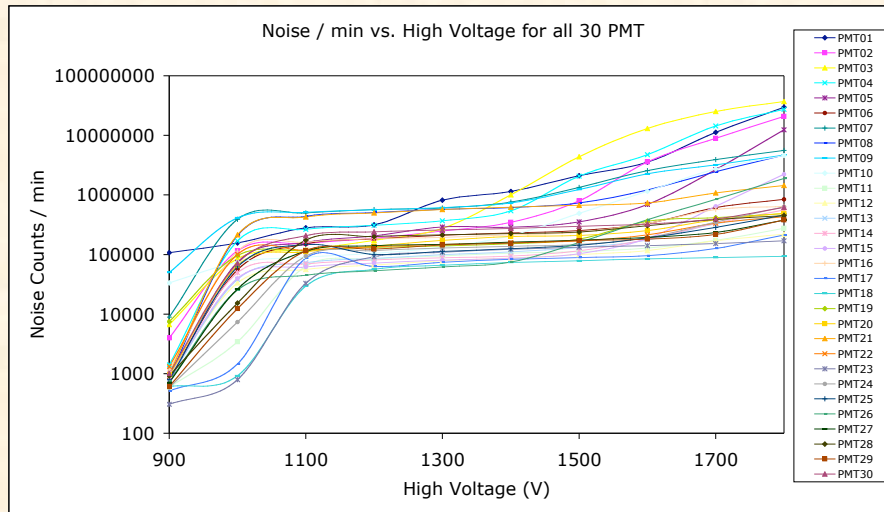
Our measured gain closely reflects the spec gain given to us by the company

Gain plot starts to break down when PMTs start to become saturated



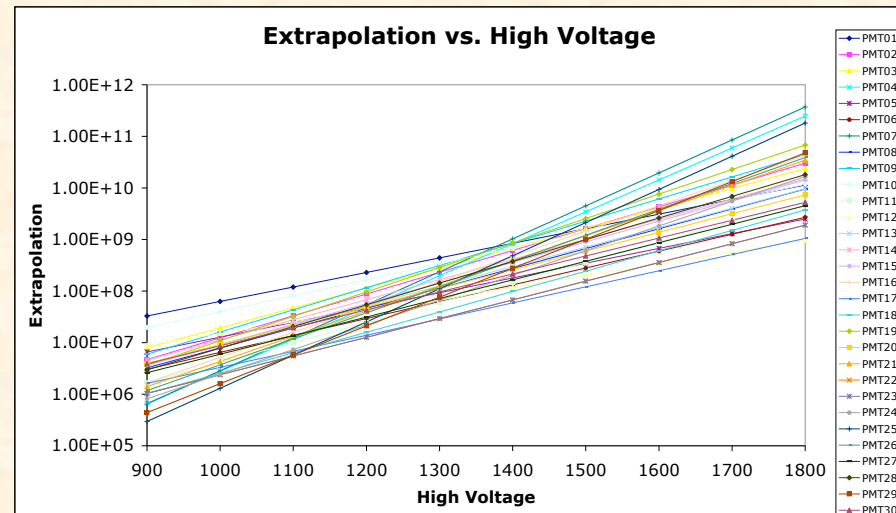
# All 30 PMT

- Noise vs. high voltage and the extrapolation for all 30 PMT



We have some very nice PMTs!!

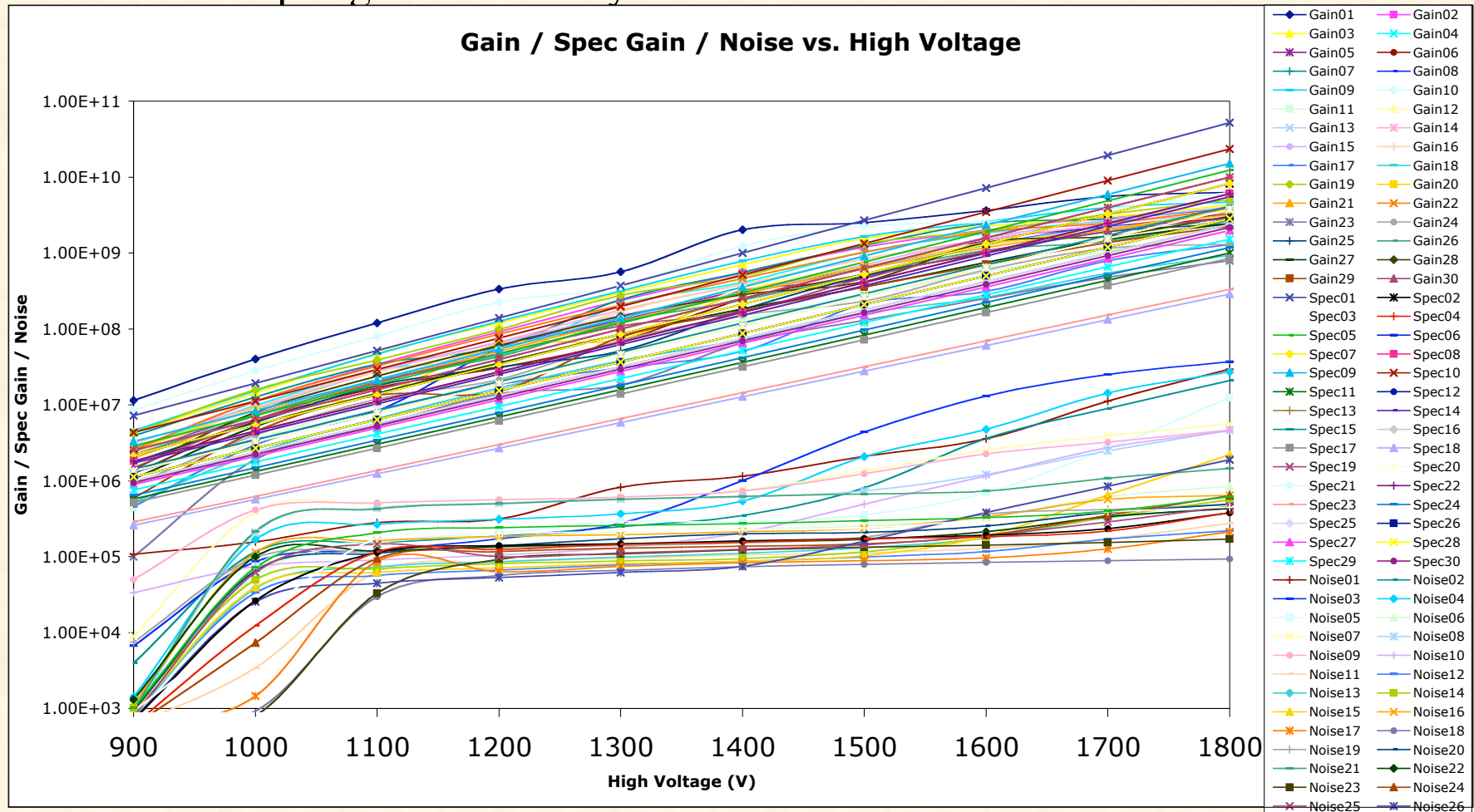
The extrapolation data will allow us to set high voltages to get specific gains





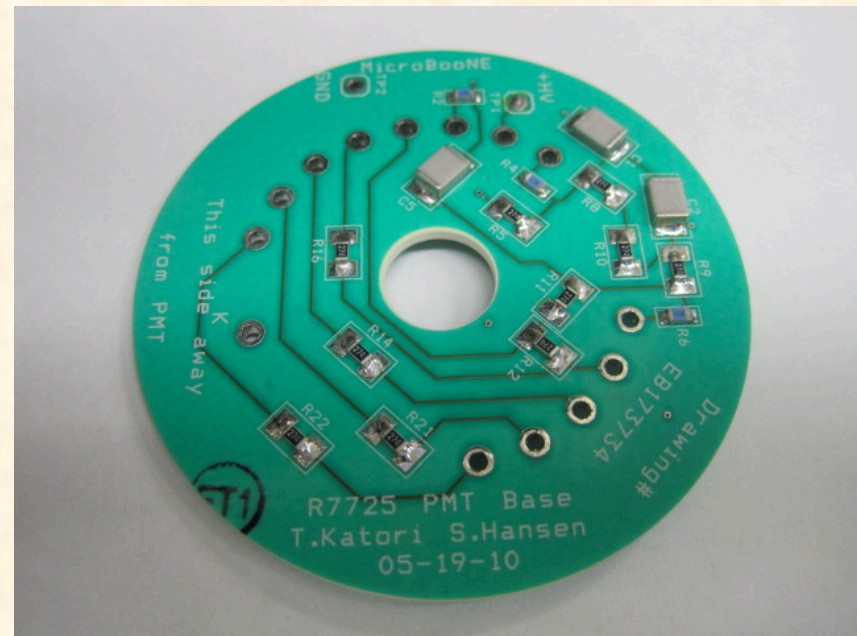
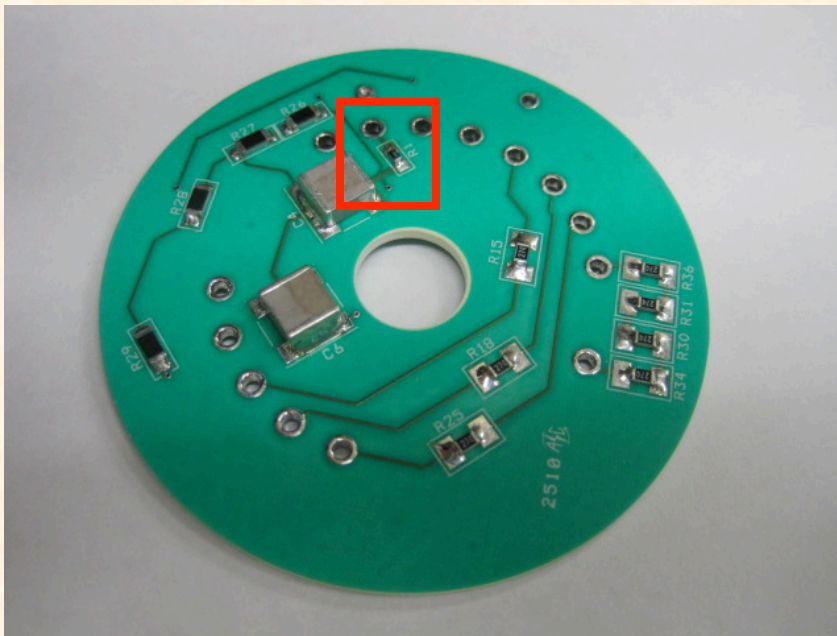
# All 30 PMT

- Gain / Spec gain / Noise layered



# Further testing

- We found that some of the PMT bases were broken and needed to be repaired
- In particular, R1 seemed to be the problem on most



# Further Testing

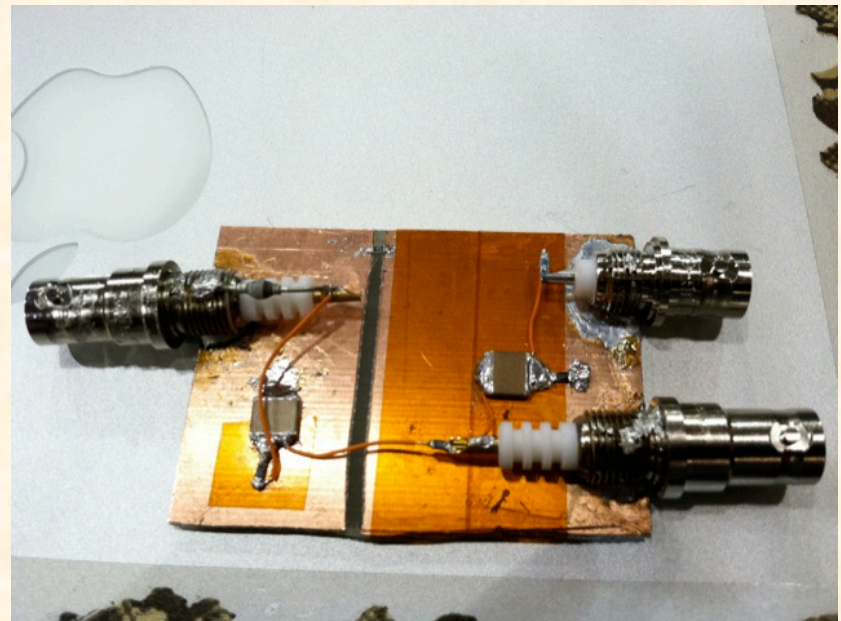
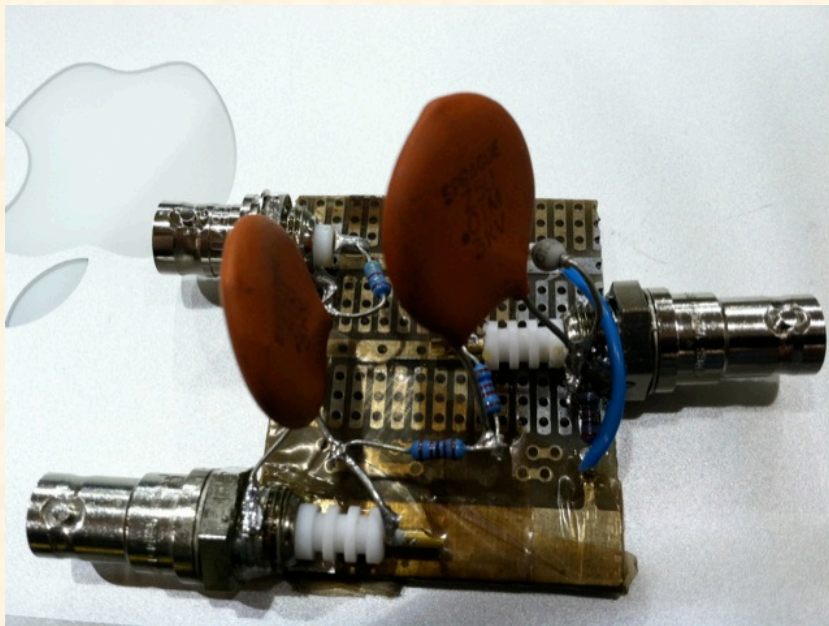
- After fixing the bases we needed to make sure the PMT bases could withstand the LAr we would be using them in





# Further Testing

- We also needed to make some splitters so we could connect the PMTs to a high voltage source and an oscilloscope to take measurements



Needless to say, I got a little bit more efficient!

# Further Testing

- We ran one test in liquid nitrogen
- Everything held up and we got a nice signal
- Testing in liquid nitrogen or LAr will be ready soon



# Greenhouses

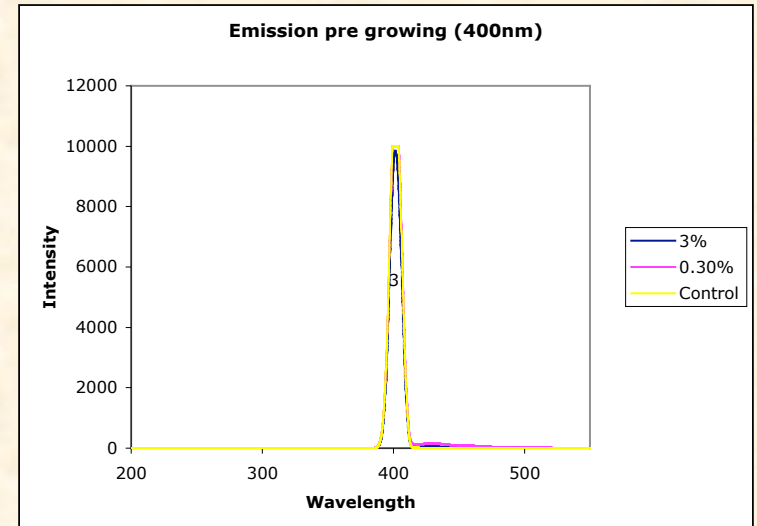
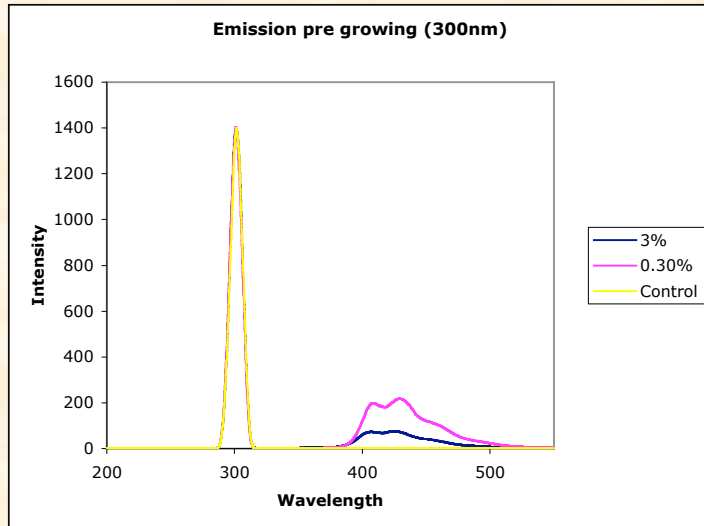
# The idea

- Our thought is to coat greenhouses with a scintillator called bis-MSB to shift the ultraviolet light into blue light
- This blue light should help the plants produce “chlorophyll a” which is used in oxygenic photosynthesis
- We need to make sure the bis-MSB will not affect transmittance and will effectively absorb UV light and emit blue light
- My plots will be illustrating the absorption / emittance of the different greenhouse lids



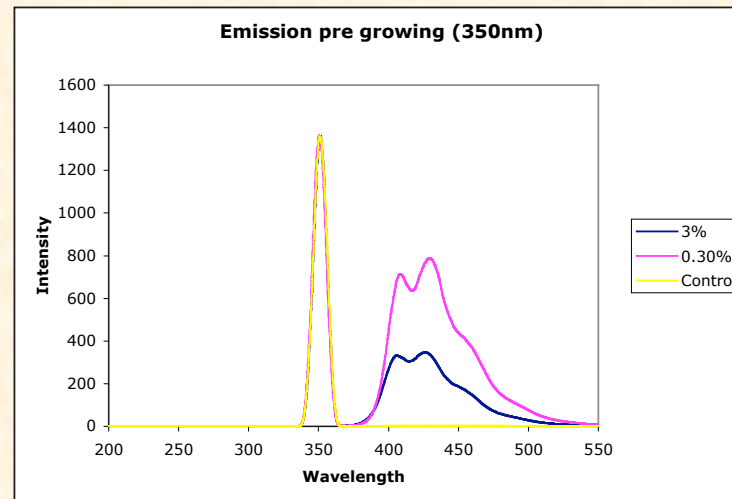
# Emission pre growing

- We used a control, 3% bis-MSB, and 0.3% bis-MSB
- We tested 3 different absorption wavelengths



As expected, an absorption of 350nm has the most efficient emittance of blue light

7/31/11

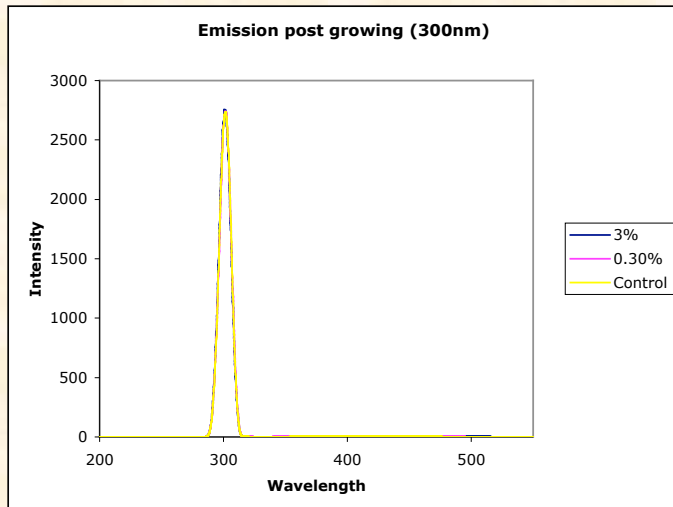


Oddly enough, a lower concentration (0.3%) has a more efficient emittance to blue light

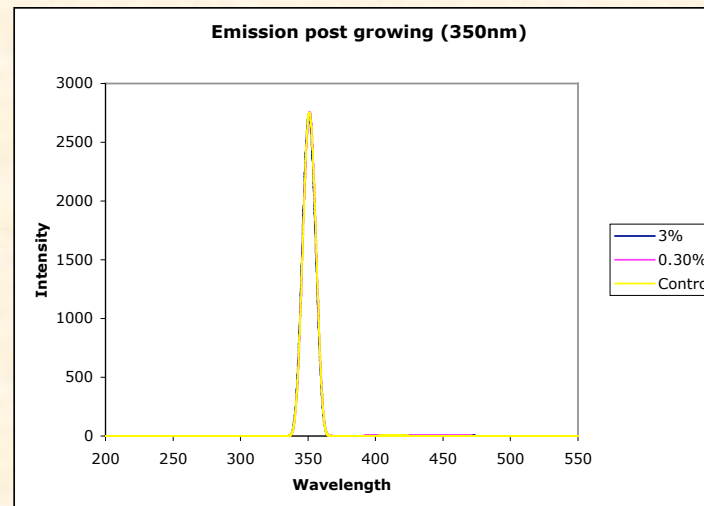
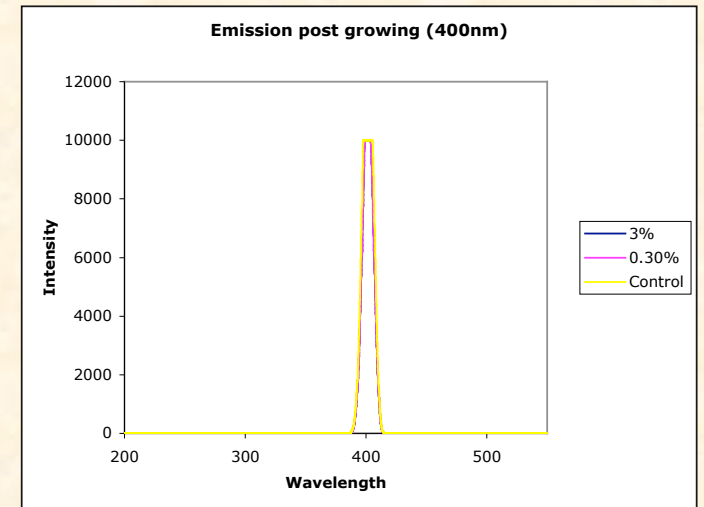


# Emission post growing

- After approximately 5 weeks of growing we retested the absorption / emittance of the three lids again
- We used the same three wavelengths

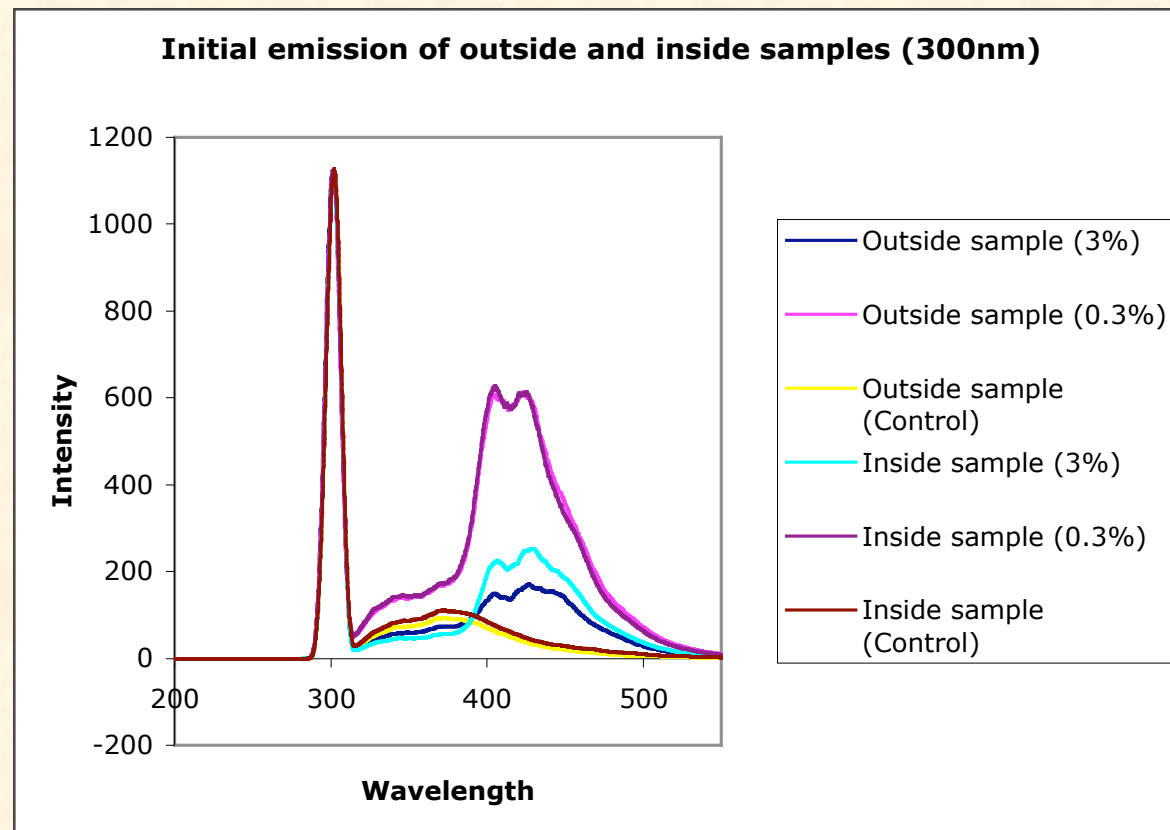


It seems as if  
our bis-MSB  
has been  
destroyed!



# Finding the problem

- Our next idea is to find out what / when the bis-MSB gets destroyed
- Our idea is to expose three samples to the outside elements and compare their emission / absorption spectrum to three samples that have remained unexposed



# Finding the problem

- We will be taking the emission / absorption spectrum of the samples each day to find when the samples lost the bis-MSB or possibly what may have destroyed the bis-MSB

